UNITED STATES DISTRICT COURT
DISTRICT OF MASSACHUSETTS

SINGULAR COMPUTING LLC, Plaintiff, v. GOOGLE LLC, Defendant.	Civil Action No. 1:19-cv-12551-FDS Hon. F. Dennis Saylor IV REDACTED VERSION ORAL ARGUMENT REQUESTED

PLAINTIFF'S MEMORANDUM OF LAW IN OPPOSITION TO DEFENDANT'S MOTION FOR SUMMARY JUDGMENT THAT THE ASSERTED PATENT CLAIMS ARE PATENT INELIGIBLE

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TABLE OF CONTENTS

TABLE OF AUTHORITIES

Cases

Plaintiff, Singular Computing LLC ("Singular"), respectfully submits this memorandum of law in opposition to the motion of defendant, Google LLC ("Google"), for summary judgment that the asserted patent claims are patent ineligible. For the reasons set forth herein, Singular requests that the motion be denied.

I. INTRODUCTION

The Singular patents cover computer hardware architecture. The asserted claims of the Singular patents are directed to a computing "device." *See* Ex. A ('273 patent), claim 53; Ex. B ('156 patent), claim 7.[1] As recited therein, the claimed computing device incorporates "execution units" that accept a dynamic range of the possible valid inputs that is "at least" as wide as from 1/1,000,000 through 1,000,000; and for "at least" 5% of the valid inputs those execution units output a signal that represents a numerical value that differs from the result of an exact mathematical calculation by "at least" 0.05%. (For shorthand, these execution units have been referred to in the patents and in this action as "LPHDR execution units," referring to the low precision (LP) and high dynamic range (HDR) within the ranges the claims specify).

The claimed computing device further requires that the number of these LPHDR execution units in the device "exceeds by at least one hundred" the number of execution units in the device "adapted to execute at least the operation of multiplication on floating point numbers that are at least 32-bits wide." (For shorthand, the parties have been referring to the latter as "full precision" or "traditional precision" execution units).

The asserted claims are thus "directed to" a computing device in which LPHDR execution units that meet these specifications predominate over full precision execution units-- by at least 100 units. The evidence shows this design differed radically from what had been the conventional

[1] Unless otherwise noted, all cited exhibits are attached to the accompanying Declaration of Kevin Gannon.

design of computing devices. As the specification describes in detail, a device incorporating this novel computer architecture enables a larger amount of arithmetic computational power with a given amount of resources than does traditional computer architectures. *See*, *e.g.*, Ex. A, col. 23, l. 48 – col. 24, l. 11. These differences from previous designs and the advantages they provide thus represent the claimed advance of these patents.

II. BACKGROUND

The Amended Complaint in this case (Dkt. No. 37) alleges infringement of three patents: U.S. Patent Nos. 8,407,273 ("the '273 patent"), 9,218,156 ("the '156 patent") and 10,416,961 ("the '961 patent"). *Id.*[2] Google filed a motion to dismiss the Amended Complaint for failure to state a claim, arguing that the claims of the patents-in-suit are directed to unpatentable subject matter under 35 U.S.C. § 101. *See* Dkt. No. 40. After briefing and a hearing, the Court denied that motion. *See* Dkt. No. 51 ("the 101 Order"). In the present motion, Google repeats the arguments made in its prior motion.

As explained *infra* and in Singular's pending motion for partial summary judgment of no invalidity under 35 U.S.C. § 101, the asserted claims pass muster under Step 1 of the *Alice*[3] test as a matter of law. *See* Dkt. No. 474. Accordingly, the Court should not need to address Google's *Alice* Step 2 argument. *See*, *e.g.*, *Visual Memory LLC v. NVIDIA Corp.*, 867 F.3d 1253, 1262 (Fed. Cir. 2017). Were the Court to address Step 2, however, the asserted claims recite sufficient improvements over the prior art so as to render them out of the routine and conventional.[4] Submitted herewith is the Rebuttal Expert Report of Singular's expert, Dr. Khatri, who opines that

[2] The '961 patent is no longer asserted in this case.
[3] *Alice Corp. v. CLS Bank Int'l*, 573 U.S. 208 (2014).
[4] This is confirmed by Google's inability to show by even a preponderance of the evidence that either of the asserted claims was obvious in view of the prior art during the *inter partes* review ("IPR") proceedings. *See*, *e.g.*, Ex. D (Final Written Decision in IPR2021-00179).

the asserted claims are eligible for patenting because they are not directed to an abstract idea and recite inventive improvements in this field of computing. *See* Declaration of Sunil P. Khatri, Ph.D. ("Khatri Decl."), Ex. 2. For these reasons, the asserted claims are not invalid under Section 101. *See*, *e.g.*, *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327, 1336 (Fed. Cir. 2016) (claims directed to "an improvement to computer functionality itself, not [to] economic or other tasks for which the computer is used in its ordinary capacity" are patent eligible).

At a minimum, the present motion should be denied because relevant material facts under step 2 of the Alice test are disputed. "[W]hether a claim element or combination of elements is well-understood, routine and conventional to a skilled artisan in the relevant field is a question of fact." *Berkheimer v. HP Inc.*, 881 F.3d 1360, 1368 (Fed. Cir. 2018) (citing *Microsoft Corp. v. i4i Ltd. P'ship*, 564 U.S. 91, 95 (2011)). As set forth below, Singular disputes Google's allegations that the asserted claims recite elements that are well understood, routine, and conventional. In the context of a motion for summary judgment, the court must view "the record in the light most favorable to the nonmovant, drawing reasonable inferences in his favor." *Noonan v. Staples, Inc.*, 556 F.3d 20, 25 (1st Cir. 2009). Thus, when the disputed facts are viewed in Singular's favor, as they must be, Google's motion should be denied.

III. LEGAL STANDARDS

Pursuant to Fed. R. Civ. P. 56, courts "shall grant summary judgment if the movant shows that there is no genuine dispute as to any material fact and the movant is entitled to judgment as a matter of law." *See also Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 247 (1986). A genuine issue is "one that must be decided at trial because the evidence, viewed in the light most flattering to the nonmovant ... would permit a rational fact-finder to resolve the issue in favor of either party." *Medina-Munoz v. R.J. Reynolds Tobacco Co.*, 896 F.2d 5, 8 (1st Cir. 1990) (citation

omitted). The moving party bears the initial burden of informing the court of the basis for its belief that there is no genuine issue for trial." *Celotex Corp. v. Catrett*, 477 U.S. 317, 323 (1986). The burden then shifts to the nonmovant to establish that there is a genuine issue of material fact. *Matsushita Elec. Indus. Co. v. Zenith Radio Corp.*, 475 U.S. 574, 586-87 (1986). The party challenging validity has the burden of proof by clear and convincing evidence. *Microsoft v. i4i*, 564 U.S. at 95. This heightened burden applies even at the summary judgment stage. *See Anderson*, 477 U.S. at 254. The court must view "the record in the light most favorable to the nonmovant, drawing reasonable inferences in his favor." *Noonan*, 556 F.3d at 25.

A claim of a patent is invalid if it is not directed to patent eligible subject matter pursuant to 35 U.S.C. § 101. Section 101 provides that a patent may be obtained for "any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof." The Supreme Court has held that the statutory definition of patent-eligible subject matter includes an implicit exception for laws of nature, natural phenomena, and abstract ideas. *See Alice*, 573 U.S. at 216. Laws of nature, natural phenomena, and abstract ideas are not patent-eligible because they are "building blocks of human ingenuity." *Id.* at 217.

The Supreme Court has articulated a two-step framework for determining patent eligibility. *See Alice*, 573 U.S. at 217-18 (citing *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 566 U.S. 66, 72-73, 77-79 (2012)). At step one, courts must determine whether the claims are "directed to" a patent-ineligible concept, such as an abstract idea. *Id.* at 218. Step one of the analysis is "purely" a question of law. *See*, *e.g.*, *Trinity Info Media, LLC v. Covalent, Inc.*, 562 F. Supp. 3d 770, 785 (C.D. Cal. 2021) (citing *CardioNet LLC v. Bionic, Inc.*, 955 F.3d 1358, 1372 (Fed. Cir. 2020)). If the party challenging patent eligibility fails to prevail on step 1, then step 2 becomes moot. *See*, *e.g.*, *Visual Memory*, 867 F.3d at 1262; *see also CardioNet*, 955 F.3d at 1371.

At step two, courts must determine whether a claim element or combination of elements is well-understood, routine and conventional to a skilled artisan in the relevant field. That "is a question of fact . . . [which] must be proven by clear and convincing evidence." *Berkheimer*, 881 F.3d at 1368. Claims directed to "an improvement to computer functionality itself, not [to] economic or other tasks for which a computer is used in its ordinary capacity" are patent eligible. *Enfish,* 822 F.3d at 1336.

IV. ARGUMENT

Google has the burden of proving patent ineligibility for both steps of *Alice* by clear and convincing evidence. *Microsoft*, 564 U.S. at 95. Google's motion fails to carry that burden.

A. *ALICE* STEP 1

Step one of the *Alice* test requires the court to determine whether a patent claim is "directed to an abstract idea." To a patent practitioner – or anyone else familiar with how patent applications and claims are drafted – "what a claim is directed to" has a narrow meaning.

In the written description, the inventor gives his views as to how his invention differs from, and provides advantages over, the prior art of which he is aware. The inventor then drafts claims to delineate the metes and bounds of that invention, in so doing capturing the expressed differences from the prior art that provide those advantages. Thus, to a patent practitioner, the inventive features that form the advance over the art define what a claim is "directed to."

The Federal Circuit has repeatedly held categorizing what a claim is "directed to" begins with looking at the claimed advance. *Affinity Labs of Texas, LLC v. DirecTV, LLC*, 838 F.3d 1253, 1257-58 (Fed. Cir. 2016) (the "'abstract idea' step of the inquiry calls upon us to look at the 'focus of the *claimed advance* over the prior art' to determine if the claim's 'character as a whole' is directed to excluded subject matter" (emphasis added); *Finjan, Inc. v. Blue Coat*

Systems, Inc., 879 F.3d 1299, 1303 (Fed. Cir. 2018) ("Starting at [*Alice*] step one, we must first examine the … patent's '*claimed advance*' to determine whether the claims are directed to an abstract idea" (emphasis added); *Intellectual Ventures I Inc. v. Capital One Fin. Corp.*, 850 F. 3d 1332, 1338 (Fed. Cir. 2017) ("Under the 'abstract idea' step we evaluate 'the "focus of the *claimed advance* over the prior art" to determine if the claim's "character as a whole" is directed to excluded subject matter'" (emphasis added); *Ancora Technologies, Inc. v. HTC America, Inc*., 908 F.3d 1343, 1347 (Fed. Cir. 2018) ("We examine the patent's '"*claimed advance"* to determine whether the claims are directed to an abstract idea'" (emphasis added); *Trading Technologies Intl., Inc. v. IBG LLC*, 921 F.3d 1084, 1092 (Fed. Cir. 2019) ("Under [the step one] inquiry, we evaluate 'the focus of the *claimed advance* over the prior art' to determine if the character of the claim as a whole, considered in light of the specification, is directed to excluded subject matter") (emphasis added); *Trading Technologies Intl., Inc., v. IBG LLC*, 921 F.3d 1378, 1384 (Fed. Cir. 2019) (same). *See also Chargepoint, Inc. v. SemaConnect, Inc*., 920 F.3d 759, 767 (Fed. Cir. 2019) ("The 'directed to' inquiry may also involve looking to the specification to understand 'the problem facing the inventor' and, ultimately, what the patent describes as the invention.")

What those cases refer to as the "claimed advance" is the difference between the claim and what the intrinsic record describes as the prior art, and the advantages that flow from that difference.

As discussed above, at pages 1-2, the claimed advance of the asserted claims here is a computing device in which the number of LPHDR execution units in the device having certain claimed technical properties predominate by at least 100 units over the number of full precision execution units in the device, which predominance enables a larger amount of arithmetic

computational power with a given amount of resource than does traditional computer architecture.

The Federal Circuit has repeatedly held eligible for patenting claims, like those here, that "recite a specific means or method that solves a problem in an existing technological process." *See*, *e.g.*, *Koninklijke KPN N.V. v. Gemalto M2M GmbH*, 942 F.3d 1143, 1150 (Fed. Cir. 2019); *see also McRO, Inc. v. Bandai Namco Games Am., Inc.*, 837 F.3d 1299, 1313-14 (Fed. Cir. 2016) (claims non-abstract because they were directed to improvement in existing process and recited "specific" rules describing the improved process for automation).

In *Koninklijke*, the Federal Circuit determined under *Alice* step 1 that the following claim is not directed to an abstract idea:

> A device for producing error checking based on original data provided in blocks with each block having plural bits in a particular ordered sequence, comprising:
>
> a generating device configured to generate check data; and
>
> a varying device configured to vary original data prior to supplying said original data to the generating device as varied data;
>
> wherein said varying device includes a permutating device configured to perform a permutation of bit position relative to said particular ordered sequence for at least some of the bits in each of said blocks making up said original data without reordering any blocks of original data;
>
> wherein the varying device is further configured to modify the permutation in time.

942 F.3d at 1147-48. The Federal Circuit found the claim non-abstract because it is "directed to an improved check data generating device that enables a data transmission error detection system to detect a specific type of error that prior art systems could not." *Id.* at 1145. In finding the claims non-abstract, the Federal Circuit explained:

> Importantly, the claims do not simply recite, without more, the mere desired result of catching previously undetectable systematic errors, but rather recite a specific solution for accomplishing that goal . . .

Id. at 1151.

In *Uniloc USA, Inc. v. LG Elecs. USA, Inc.*, 957 F.3d 1303 (Fed. Cir. 2020), the Federal Circuit found that the following claim satisfied the requirements of *Alice* step 1:

> 2. A primary station for use in a communications system comprising at least one secondary station, wherein means are provided
>
> for broadcasting a series of inquiry messages, each in the form of a plurality of predetermined data fields arranged according to a first communications protocol, and
>
> for adding to each inquiry message prior to transmission an additional data field for polling at least one secondary station.

Id. at 1305-06. The Federal Circuit stated:

> In accordance with [our] precedent, we hold the claims at issue are directed to a patent-eligible improvement to computer functionality, namely the reduction of latency experienced by parked secondary stations in communication systems. Claim 2 of the '049 patent recites a primary station for use in a communication system "wherein means are provided for ... adding to each inquiry message prior to transmission an additional data field for polling at least one secondary station." '049 patent at Claim 2. The additional data field enables a primary station to simultaneously send inquiry messages and poll parked secondary stations. *Id.* at Abstract. The claimed invention therefore eliminates or reduces the delay present in conventional systems where the primary station alternates between polling and sending inquiry messages. *See, e.g.*, *id.* at 2:8–15, 6:55–60. Therefore, like the claims in *DDR*, the claimed invention changes the normal operation of the communication system itself to "overcome a problem specifically arising in the realm of computer networks." *See* 773 F.3d at 1257–58. In doing so, the claimed invention, like the improvement in computer memory we held patent eligible in *Visual Memory*, enables the communication system to accommodate additional devices, such as battery-operated secondary stations, without compromising performance. *See* 867 F.3d at 1258–60.

Id. at 1307-08.

The asserted claims in this case are also similar in terms of the *Alice* step 1 analysis to the representative claim recently upheld under Section 101 by the Federal Circuit in *Adasa Inc. v. Avery Dennison Corp.*, 55 F.4th 900 (Fed. Cir. 2022):

> 1. An RFID transponder comprising:

> a substrate;
>
> an antenna structure formed on the substrate; and
>
> an RFID integrated circuit chip which is electrically coupled to the antenna structure;
>
> > wherein the RFID integrated circuit chip is encoded with a unique object number, the unique object number comprising an object class information space and a unique serial number space;
> >
> > wherein the unique serial number space is encoded with one serial number instance from an allocated block of serial numbers, the allocated block being assigned a limited number of most significant bits;
> >
> > wherein the unique serial number space comprises the limited number of most significant bits uniquely corresponding to the limited number of most significant bits of the allocated block and of remaining bits of lesser significance that together comprise the one serial number instance.

Id. at 905-06. The Federal Circuit agreed with the district court that this claim "focused on improvements to the technical process by which [the] data is encoded" and passed *Alice* step 1. *Id.* at 908-09.

In *Core Wireless Licensing S.A.R.L. v. LG Elecs., Inc.*, 880 F3d 1356 (Fed. Cir. 2018), the Federal Circuit affirmed the denial of summary judgement of patent ineligibility under *Alice* step 1 with respect, *inter alia*, to the following claim:

> A computing device comprising a display screen, the computing device being configured to display on the screen a menu listing one or more applications, and additionally being configured to display on the screen an application summary that can be *reached directly* from the menu, wherein the application summary displays a limited list of data offered within the one or more applications, each of the data in the list being selectable to launch the respective application and enable the selected data to be seen within the respective application, and wherein the application summary is displayed while the one or more applications are in an *un-launched state*.

The court noted that, as in other cases where step 1 was satisfied, the claim "recite[s] a specific improvement over prior systems." *Id.* at 1363.

In the Claim Construction Order in this action, this Court succinctly related the problems with the prior art that are described in the specifications of the asserted patents:

> According to the patents, conventional central processing units (CPUs") perform arithmetical operations, such as addition, subtraction, multiplication, and division, with "great precision," which typically requires "on the order of a million transistors." (['273 patent] col. 3 ll. 7-22). Although such CPUs "make inefficient use of their transistors," this high-precision architecture remains the norm because "[m]any applications need this kind of precision" and it preserves "software compatibility with earlier designs." (*Id.*, *see also id.* col. 5 ll. 41-65).
>
> Because of the inefficiency of conventional CPU designs, "other kinds of computers have been developed to attain higher performance." (*Id.* col. 3 ll. 31-32). The patent describes a variety of such architectures, including single instruction stream/multiple data stream designs, field programmable gate arrays, and graphic processing units ("GPUs"). (*See generally id.* col. 3 l. 30-col. 5 l. 62). The patent claims that while many of those architectures use lower-precision arithmetic and may have advantages for specialized applications, they suffer from a variety of flaws that either prevent their use for modern general-purpose computing or render them approximately as inefficient as conventional CPU designs. (*See generally id.*).

CCO (Dkt. No. 354), at pp. 2-3; *see also* Ex. A ('273 patent), at col. 1, ll. 52-60; col. 7, ll. 12-20. The problems with the prior art computing systems are also described in the Expert Report of Dr. Khatri. *See* Khatri Decl., Ex. 1, at pp. 12-13, ¶ 62. The problems were also described in Singular's IPR briefing (*see*, *e.g.*, Ex. C, at pp. 4-6) and in the Final Written Decisions in the IPR proceedings. *See*, *e.g.*, Ex. D, at pp. 3-4.

Here, as in *Koninklijke*, *Uniloc*, *Adasa*, and *Core Wireless*, the asserted claims "recite a specific solution" using Dr. Bates's novel LPHDR computing devices for solving problems with the use of transistors in existing devices. To that end, claim 53 of the '273 patent recites as follows:

> A device:
>
> comprising at least one first low precision high-dynamic range (LPHDR) execution unit adapted to execute a first operation on a first input signal representing a first numerical value to produce a first output signal representing a second numerical value,
>
> wherein the dynamic range of the possible valid inputs to the first operation is at least as wide as from 1/1,000,000 through 1,000,000 and for at least X=5% of the possible valid inputs to the first operation, the statistical mean, over repeated execution of the first operation on each specific input from the at least X % of the possible valid inputs to the first operation, of the numerical values represented by the first output signal of the LPHDR unit executing the first operation on that input differs by at least Y=0.05% from the result of an exact mathematical calculation of the first operation on the numerical values of that same input;
>
> wherein the number of LPHDR execution units in the device exceeds by at least one hundred the non-negative integer number of execution units in the device adapted to execute at least the operation of multiplication on floating point numbers that are at least 32 bits wide.

See '273 patent (Ex. A), cols. 31-32.[5]

Claim 53 recites a "specific solution" for solving the problems with the prior art. For example, this claim recites a "specific" dynamic range of "from 1/1,000,000 through 1,000,000 and for at least X=5% of the possible valid inputs to the first operation" and a specific floor for the error rate "of at least Y=0.05% from the result of an exact mathematical calculation of the first operation on the numerical values of that same input" as well as a specific floor on the number of LPHDR execution units that must "exceed[] by at least one hundred the non-negative integer number" of full-precision units. Claim 7 of the '156 patent recites the same specific limitations. *See* Ex. B, cols. 29-30.

In *Uniloc*, the Federal Circuit discussed its step 1 precedents – using language (shown in bold added) that would seem to apply to the claimed advance here -- regarding patent-eligible improvements to computing technologies:

> In *DDR Holdings, LLC v. Hotels.com, L.P.*, for example, we held patent eligible claims directed to a system for generating a hybrid web page that maintained the "look and feel" of a host website. 773 F.3d 1245, 1257–59 (Fed. Cir. 2014). We emphasized that in "**overcom[ing] a problem specifically arising in the realm of**

[5] Claim 53 of the '273 patent depends from claim 43 that, in turn, depends from independent claim 36.

> **computer networks," the claimed invention changed the normal operation of the computer network itself and was "necessarily rooted in computer technology**." *Id.* at 1257–58. Similarly, in *Enfish, LLC v. Microsoft Corp.*, we held patent eligible claims directed to a self-referential database that **improved the way computers operated** and handled data, allowing the more efficient launching and adaptation of databases. 822 F.3d 1327, 1336–39 (Fed. Cir. 2016). And in *Visual Memory LLC v. NVIDIA Corp.*, we held patent eligible **claims "focus[ed] on a 'specific asserted improvement in computer capabilities**,' " namely the accommodation of different types of processors without compromising performance. 867 F.3d 1253, 1259–60 (Fed. Cir. 2017). In holding the claims patent eligible, we noted that the claims were not directed to categorical data storage but rather were limited to certain types of data to be stored. *Id.*
>
> In *Ancora Technologies, Inc. v. HTC America, Inc.*, we held patent eligible claims directed to **a non-abstract improvement to computer security**. 908 F.3d 1343, 1347–49 (Fed. Cir. 2018). We determined the claims addressed the "vulnerability of license-authorization software to hacking" and were thus "**directed to a solution to a computer-functionality problem**." *Id.* at 1349; *see also Finjan*, 879 F.3d at 1304–06 (holding that claims to a "behavior-based virus scan" provided greater computer security and were thus directed to **a patent-eligible improvement in computer functionality**). In *Data Engine Technologies LLC v. Google LLC*, we held patent eligible claims reciting "a specific method for navigating through three-dimensional electronic spreadsheets" because **the claimed invention "improv[ed] computers' functionality** as a tool able to instantly access all parts of complex three-dimensional electronic spreadsheets." 906 F.3d 999, 1007–08 (Fed. Cir. 2018). And in *Core Wireless Licensing S.A.R.L. v. LG Electronics, Inc.*, we held patent eligible claims directed to an improved user interface that enabled users to more quickly access stored data and programs in small-screen electronics. 880 F.3d 1356, 1359–63 (Fed. Cir. 2018). We determined that the claimed invention in *Core Wireless* "improve[d] the efficiency of using the electronic device by bringing together a limited list of common functions and commonly accessed stored data, which can be accessed directly from the main menu." *Id.* at 1363. We therefore held that "**the claims [we]re directed to an improvement in the functioning of computers**, particularly those with small screens." *Id.*

Uniloc, 957 F.3d at 1307. As in those cases, and as in *Koninklijke*, the asserted claims in this case are patent-eligible because they cite a specific solution – a computer device that includes, *inter alia*, a predominance – by at least 100 – of certain LPHDR execution units over full-precision units – that solves the problem of the inefficient use of transistors by previous computers.

Google argues as to step 1 that a mathematical operation with low precision and high dynamic range is, in isolation, an "abstract idea." *See* Google Br., p. 1. It further argues that the

asserted claims do not limit, at least technically, how to design the LPHDR execution unit. *Id.*, p. 3. Google acknowledges, however, that the asserted claims go further, by specifying design criteria such as precision and range limits for the LPHDR execution units --and by requiring that LPHDR execution units in the computing device predominate (by at least 100) over full-precision units in the device. *See id.*, pp. 7-10. As to the latter, Google does not appear to dispute that imposing the predominance of LPHDR execution units the claims require represents an improvement in computer architecture. Rather, Google simply observes that the claims are broad enough to embrace varying degrees of LPHDR execution unit predominance -- which is true but irrelevant for section 101 purposes.

Finally, Google attempts to liken the claims here to those in *Parker v. Flook*, 437 U.S. 584 (1978), which were directed to a method of calculating, using a mathematical formula, and *Gottschalk v. Benson*, 409 U.S. 63 (1972), which were directed to a method for converting binary-coded decimals into pure binary numerals, which was not limited to any particular art or technology. But *Diamond v. Diehr*, 450 U.S. 176 (1981), distinguished those cases, holding that the process claims there were eligible, despite that in several steps of the process a "well known" mathematical equation was used. *Id*. at 187. The Court concluded: "a claim drawn to subject matter otherwise statutory does not become nonstatutory simply because it uses a mathematical formula." *Id*. The asserted claims in this case are statutory as they are drawn to a computing device with structural limitations that require a predominance by more than 100 of LPHDR execution units over full-precision execution units. That both types of execution units perform arithmetic computation does not render the claims nonstatutory.

B. *ALICE* STEP 2

"The second step of the *Alice* test is satisfied when the claim limitations involve more than performance of well-understood, routine and conventional activities previously known to the industry." *Berkheimer*, 881 F.3d at 1367 (cleaned up). "[W]hether something is well-understood, routine, and conventional to a skilled artisan at the time of the patent is a factual determination." *Id.*, 881 F.3d at 1369. In his Rebuttal Expert Report, Dr. Khatri explains in detail how the asserted claims are directed to inventive concepts. *See* Khatri Decl., Ex. 2, at pp. 61-65, ¶¶ 0255-0272. For example, Dr. Khatri states as follows:

> [0259] Prior art systems utilized full-precision execution units that take up space and are wasteful of transistors. *See e.g.* '273 Patent at col. 5 ll. 6-10.
>
> [0260] The device of claim 53 of the '273 Patent substantially and structurally differs from devices in the prior art because it includes LPHDR processing circuits with particular parameters of precision and dynamic range. Prior computing architectures did not include such processing circuits.
>
> [0261] Building the devices claimed in the Asserted Claims required the design and manufacture of hardware different from the hardware used in conventional processing units, since conventional hardware at the time was completely unsuitable to implement the inventions.
>
> [0262] By deploying massive numbers of Dr. Bates' LPHDR execution circuits in conjunction with far smaller numbers of higher precision processing elements—at least 100 fewer—the device of claim 53 executes a far larger number of operations per clock period than a conventional computer while still supporting operations performed at a large precision and large dynamic ranges.
>
> [0263] The Asserted Claims improved upon conventional computing by executing a far larger number of operations per clock period, while supporting software programs that require operations to be performed on numbers having high dynamic range, by: adding to a computer at least 100 LPHDR units, each LPHDR unit manipulating numbers having a dynamic range of at least 1,000,000 to 1/1,000,000, and each LPHDR unit's operations being imprecise by at least 0.05% for at least 5% of its possible valid inputs, and combining with that number of LPHDR units, a far smaller number of execution units that each execute the operation for multiplication on floating point values that are at least 32 bits wide, that far smaller number being at least 100 fewer than the number of LPHDR units in the computer.

[0266] The inventions of the Asserted Claims are not conventional and are indeed an improvement to computer technology. For example:

- Reducing the invention to practice required the design and manufacture of hardware different from the hardware used in conventional processing units, because conventional hardware at that time was unsuitable to implement the invention.
- The claimed advance to which the claims are directed was a computer that can execute a far larger number of operations per period than a conventional computer, while supporting software programs that require operations to be performed on numbers having high dynamic range, by adding to a computer at least 100 LPHDR units, each LPHDR unit manipulating numbers having a dynamic range of at least 1,000,000 to 1/1,000,000, and each LPHDR unit's operations being imprecise by at least 0.05% for at least 5% of its possible valid inputs; and further by combining with that number of LPHDR units, a far smaller number of execution units that each execute the operation of multiplication on floating point values that are at least 32 bits wide, that far smaller number being at least 100 fewer than the number of LPHDR units in the computer.

[0271] Low Precision: Dr. Gustafson further argues that by establishing boundaries for the degree of precision required by the claim, the patent does not disclose a concrete technological innovation. Gustafson Rpt. at ¶714. The notion of implementing low precision arithmetic in computing systems was contrary to the prevailing thought at the time, as was the concept of combining low precision with high dynamic range. *See* '273 Patent at 7:5-11 and 7:27-32. In my opinion, specifying the minimal degree of imprecision necessary gives the claim sufficient definition to allow the claim to define a concrete technological innovation. In my opinion, the use of the term "at least" within the Asserted Claims sets parameters for the dynamic range of possible inputs and allows the claims to embody a concrete technological innovation. The Asserted Claims improve the overall function of a computer by limiting the claimed LPHDR execution unit to defined parameters for both low precision and high dynamic range.

In *Amdocs (Israel) Ltd. v. Openet Telecom, Inc.*, 841 F.3d 1288 (Fed. Cir. 2016), the district court held that the following claim lacked inventive concept:

> 1. A computer program product embodied on a computer readable storage medium for processing network accounting information comprising:
>
> computer code for receiving from a first source a first network accounting record;
>
> computer code for correlating the first network accounting record with accounting information available from a second source; and
>
> computer code for using the accounting information with which the first network accounting record is correlated to enhance the first network accounting record.

Id. at 1299. The Federal Circuit reversed, finding that, although under step 2 the claimed components "may be generic at first blush," the claims "describe a specific, unconventional technological solution." *Id.* at 1306. As in *Amdocs*, the asserted claims here pass step 2 of the *Alice* test.

In *Berkheimer*, the Federal Circuit vacated the district court's grant of summary judgment under *Alice* Step 2 due to the existence of factual disputes regarding whether the claims recite well-understood, routine and conventional activities to a skilled artisan (such as Dr. Khatri in this case):

> At this stage of the case, however, there is at least a genuine issue of material fact in light of the specification regarding whether claims 4–7 archive documents in an inventive manner that improves these aspects of the disclosed archival system. Whether claims 4–7 perform well-understood, routine, and conventional activities to a skilled artisan is a genuine issue of material fact making summary judgment inappropriate with respect to these claims.

881 F.3d at 1360.

Here, as explained by Dr. Khatri, the claimed LPHDR devices operate in an uncommon, unconventional manner to provide an improvement in computing that solves the problem identified in the specification of the patents and by the Court in the CCO. As in *DDR*, the claimed device does not operate in "a normal expected manner." *See DDR Holdings, LLC v. Hotels.com, L.P.*, 773 F.3d 1245, 1258 (Fed. Cir. 2014). Instead of performing operations on high dynamic range inputs at IEEE floating point precision (also known as "full" precision), as was conventional in previous computer devices, a large number and significant majority of the claimed device's execution units perform on high dynamic range inputs at significantly reduced precision, which is "not merely the routine or conventional." *Id.* at 1259. As the Federal Circuit stated, "[i]n short, the claimed solution amounts to an inventive concept for resolving this particular [computing] problem, rendering the claims patent-eligible." *Id.*

In addition to the language of the claims, the specification may provide evidence that the claims recite inventive concepts, such as improvements over the existing technologies and unconventionality. *See*, *e.g.*, *Cosmokey Sol.'s GmbH & Co. KG v. Duo Security LLC*, 15 F.4th 1091, 1093 (Fed. Cir. 2021). The specification of the asserted patents describes the new, uncommon, and unconventional improvements provided by the claimed LPHDR devices:

> Embodiments of the present invention efficiently provide computing power using a fundamentally different approach than those described above. In particular, embodiments of the present invention are directed to computer processors or other devices which use low precision high dynamic range (LPHDR) processing elements to perform computations (such as arithmetic operations).

Ex. A, col. 5, ll. 63-6, l. 2.

> [T]he area of the arithmetic circuits remains relatively small and a greater number of computing elements can be fit into a given area of silicon. This means the machine can perform a greater number of operations pe unit of time or per unit power, which gives it an advantage for those computations able to be expressed in the LPHDR framework.

Id., col. 6, ll. 17-22.

> Such a processor or other device has not been described or practiced as a means of doing general purpose computing by those having ordinary skill in the art for at least two reasons. First, it is commonly believed by those having ordinary skill in the art that LPHDR computation, and in particular massive amounts of LPHDR computation, whether performed in a massively parallel way or not, is not practical as a substrate for moderately general computing. Second, it is commonly believed by those having ordinary skill in the art that massive amounts of even high precision computation on a single chip or in a single machine, as is enabled by a compact arithmetic unit, is not useful without a corresponding increase in bandwidth between processing elements within the machine and into and out of the machine because computing is wire limited and arithmetic can be considered to be available at no cost.

Id., col. 6, ll. 55-7, l. 4.

> [I]n fact a variety of useful and important algorithms can be made to function adequately at much lower than 32 bit precision in a massively parallel computing framework, and certain embodiments of the present invention support such algorithms, thereby offering much more efficient use of transistors, and thereby provide improved speed, power, and/or cost, compared to conventional computers.

Id., col. 7, ll. 32-39.

> One aspect of embodiments of the present invention that is unique is the inclusion of LPHDR arithmetic mechanisms in the P[rocessing]E[lement]s.

Id., col. 11, ll. 49-51.

> To perform many calculations sequentially with 1% error and yet produce a final result with less than 1% error may seem counter-intuitive. Nonetheless, the LPHDR arithmetic proves effective, and the accuracy shown is high enough to be useful in applications for which approximate nearest neighbor calculations are useful.

Id., col. 20, ll. 34-39.

Google itself has recognized that the claimed LPHDR solution was not well-understood, routine or conventional. Prior to Dr. Bates's disclosing his LPHDR invention to Google, Google was using [redacted] in its data centers for processing information. [redacted] As one of Google's chief engineers (Jeffrey Dean) described it, [redacted] *See* Ex. E, pp. 76-77; Ex. F, p. 9/24. As Google itself has stated, [redacted] that uses the LPHDR technology that Dr. Bates invented. *See* Ex. G, p. GOOG-SING-00133475. Notwithstanding that Google employed thousands of engineers, and was [redacted]

[redacted] Google did not come up with the LPHDR solution. Thus, the LPHDR solution was not well-understood, routine, or conventional to those in the know in this field of computing.

During its urgent search for a solution to its increasingly apparent AI computing shortcomings, Google invited Dr. Bates to come to Google on several occasions to discuss his LPHDR technology. *See*, *e.g.*, Ex. H [redacted] Google was [redacted] *See* Ex. I, p. SINGULAR-00018413. Google was interested because Dr. Bates's LPHDR chips were designed to run at speeds "10,000x faster than a CPU." *See id.*, p. SINGULAR-00018412. One of Google's top computing engineers, Dr. Andrew Ng, (and others at Google) specifically [redacted]

At Google's invitation, Dr. Bates disclosed his LPHDR inventions orally and in writing to Google. *See*, *e.g.*, Ex. K; Ex. L; Ex. M; Ex. N. Google's [redacted] with Dr. Bates's solution. For example, Dr. Astro Teller,[6] described it to Google's [redacted] *See* Ex. K; *see also* Ex. O, at p. 37, l. 10 – p. 39, l. 6.[7] In Google technical parlance, a Google [redacted] is technology that has [redacted]. *See* Ex. P, at 43:4-15. Top Google engineer Dr. Andrew Ng[8] described the LPHDR technology as [redacted] *See* Ex. I, p. SINGULAR-00018412; *see also* Ex. P, at p. 41, ll. 8-21.

[6] Dr. Teller has a B.S. in Computer Science from Stanford University, an M.S. in Symbolic and Heuristic Computation from Stanford, and a Ph.D. in Computer Science from Carnegie Mellon University. *See* Ex. O, p. 9.

[7] Dr. Teller also sent a copy of one of Dr. Bates's [redacted] *See* Ex. O, at p. 37, l. 21 – p. 39, l. 3.

[8] Dr. Ng is described on Wikipedia as "one of the world's most influential computer scientists being named one of *Time* magazine's 100 Most Influential People in 2012, and *Fast Company's* Most Creative People in 2012"). *See* Ex. Q, p. 1/9. Thus, at the time he described Dr. Bates's invention, he was no technological slouch. Also, he has degrees in Computer Science from Carnegie Mellon University (B.S.) ("Graduated at top of class"), the Massachusetts Institute of Technology (M.S.) and the University of California at Berkeley (Ph.D.). *See* Ex. R.

Yet another Google engineer [redacted] found Dr. Bates's LPHDR design to be [redacted] and [redacted] *See* Ex. S, p. GOOG-SING-00083650. Google's [redacted] stated that Dr. Bates's had [redacted] at Google. *See* Ex. T.[9] The Google [redacted] *See* Ex. G, at p.GOOG-SING-00133471. According to Google Research, use of the accused TPU chips allowed Google to avoid [redacted]:

> [redacted]

See id. at p. 00133475.

Moreover, the improvements provided by use of the claimed LPHDR devices, operating within the technical parameters set forth in the asserted claims, are so significant that Google [redacted] *See* Ex. G, p. GOOG-SING-00133476; *see also* Ex. V, pp. 8-9; Ex. W, pp. 6-9. The above evidence demonstrates that Google's *Alice* step 2 argument to this Court is contradicted by its own actions and admissions. As Singular denies that the asserted claims are directed to subject matter that was well-understood, routine, or conventional, there is at least a genuine issue of material fact regarding step 2 of *Alice*. Thus, summary judgment should be denied. *See*, *e.g.*, *Berkheimer*, 881 F.3d at 1370.

[9] Several years later in 2017, when Google [redacted] *See* Ex. U.

REQUEST FOR ORAL ARGUMENT

Pursuant to Local Rule 7.1(d), Singular requests the Court to entertain oral argument on this motion, as Singular believes such will assist the Court in resolving the motion.

Dated: May 19, 2023

Respectfully submitted,

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CERTIFICATE OF SERVICE

I certify that all counsel of record who have consented to electronic service are being served with a copy of this document via the Court's CM/ECF system.

/s/ Kevin Gannon